NEW YORK ENTOMOLOGICAL SOCIETY
LXXXVII(1), 1979, pp. 78–84

NEST OF THE WASP *CLYPEARIA WEYRAUCHI* (HYMENOPTERA, VESPIDAE)

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Abstract.—The nest of the Neotropical social wasp *Clypearia weyrauchi* Richards is described for the first time. It consists of a single comb of sessile cells built directly on a tree trunk and covered by a domed envelope with an entrance below the center. The envelope does not contact the comb and is not thickened. It is unusual in having its outer surface coated with a layer of transparent film, probably a glandular secretion. This film serves to strengthen the crumbly, granular carton, which consists primarily of stone cells. The same film coats and strengthens the cell walls. Despite the fact that one of the two colonies examined appeared to be completing its cycle, its nest had not been enlarged beyond its initial size, a rare phenomenon among social wasps.

There are two reasons why the study of social wasps' nests is important. First, since the nest serves as a boundary between the external and internal environments of the colony, it must be considered in any study of the behavioral ecology of a species. Second, since nest construction behavior evolves, and since many of the details of nest architecture are species specific, nests provide valuable behavioral input into phylogenetic studies of the social Vespidae. Though the range of diversity of major architectural types is known (Jeanne, 1975), for studies of the behavioral ecology and phylogeny of the wasps we need to know such details as the type of cell construction, manner of thickening the envelope, material used, texture and strength of the carton, and the extent of the use of oral secretion in the nest. This kind of knowledge exists for the nests of only a small fraction of the approximately 700 species of social wasps. The Neotropical social wasp genus *Clypearia* comprises seven species (Richards, 1978); the nests of two, *C. apicipennis* and *C. angustior*, are known (Ducke, 1910; Araujo, 1951), though Ducke's description of the nest of *C. apicipennis* was limited to one sentence. The purpose of the present paper is to describe the nest of a third species, *C. weyrauchi* Richards. All three species construct a single comb of cells directly on the surface of a tree trunk or limb, and cover it with a single-layered envelope, but the nest of *C. weyrauchi* differs in several interesting details from those of its congeners.

The following description is based on two nests collected near Santarém, Pará, Brazil (2°32′S, 54°20′W). Both were located in the same grove of trees

standing in a brushy pasture at the edge of the *varzea* (annually inundated floodplain of the Amazon River).

The larger of the two nests (no. 1112) was collected at night on July 26, 1975. It was situated at a height of about 7 m on the underside of a large horizontal branch. Though well sheltered from rain, the nest was not obscured by foliage. The nest was 45 cm long by 18 cm wide and contained approximately 1000 cells. This colony was evidently in the last stages of decline, for the nest contained only 12 adults and the brood cells were empty except for a few scattered pupae. The second nest, illustrated in Fig. 1, was collected from a nearby tree of the same species before dawn on August 14, 1977. It was also approximately 7 m high and very exposed, but the colony had chosen a nearly vertical section of tree trunk. The nest was 25.5 cm long by 9 cm wide and contained 287 cells. The adult population comprised 74 females, and the cells contained brood in all stages of development.

Envelope

The envelopes were constructed entirely by the edge construction technique, the primary form of construction of all vespid nests so far described (Jeanne, 1973). At no point were the envelopes thickened by the addition of pulp to their surfaces. The thickness of the carton varied between 0.75 and 0.85 mm.

The absence of surface thickening means that the pattern of construction of the envelope remains unobscured. This pattern is due to the lines of growth representing individual loads of carton pulp added by the wasps, and is visible in Fig. 1. The pattern for each nest indicates that the envelope was built at the outset to its final size, and was not enlarged from a smaller original envelope. In the smaller nest (Fig. 1) the lines of growth indicate that the envelope was raised uniformly around the entire comb to a height of 1.0–1.5 cm, but that then carton was added to the two ends, and especially the upper end, faster than at the sides. The entrance, which results from the incomplete closure of the envelope, is consequently positioned below the middle of the nest. In the smaller nest the entrance was 1 cm in diameter. There was no thickening of the carton around the rim of the entrance, nor was there any flaring outward of the rim to form a tube or spout.

The larger nest had two entrances. The pattern of growth lines around one of these was very irregular, suggesting that this part of the envelope had been damaged and repaired, leaving the second entrance.

The envelope was constructed of a non-fibrous, finely granular material. Under the dissection microscope the individual particles could readily be broken up into finer granules 0.01–0.02 mm in diameter. These appear to be stone cells, most commonly found in the cortex of young stems, bark, and in fruit and seed coats (R. C. Koeppen, personal communication). Micro-

scopic examination also revealed minute amounts of an almost clear, plastic-like film intermingled with the particles and serving to bind them loosely together. This substance is probably a salivary secretion that is mixed with the particles as they are masticated before being applied to the nest. This matrix is very weak and the resulting carton very crumbly.

The envelope is given added integrity by a thin surface coating of what is presumably more of the same salivary secretion. This material is evidently added after the envelope is completed, for it forms a discrete film on the outer surface of the carton, even extending for several mm onto the adjacent substrate.

It is this thin pliable film that gives the envelope what little strength it has. Flexing the envelope readily cracked the carton, and with a minimum of abrasion of the uncoated inner surface the carton crumbled away, leaving only the outer film and a few scattered particles of carton adhering directly to it. At the time of collection of each nest there were several such "windows," some several cm across, that appeared to have originated by such loss of the underlying carton (Fig. 1). It is not known whether these windows were intentionally produced, or whether they simply resulted from wear and tear.

The intact nests *in situ* were rather inconspicuous. This was partly because the sloping sides of the envelope helped eliminate shadows, and partly because the nest closely matched its substrate in color. The close color resemblance of carton and bark, and the fact that the carton is composed largely of stone cells, suggest that the source of carton material might have been the bark of the tree on which each colony nested. The translucent coating of secretion over the envelope further subdued any contrast between the nest and the tree trunk.

Comb and Brood

The comb of each nest was centered within the space enclosed by the envelope. A space of 1.3–4.5 cm separated the edge of the comb from the line of attachment of the envelope to the substrate. Thus the envelope is not initiated by the elongation of the walls of peripheral cells, but is built up from the substrate completely independently of the comb (Fig. 2).

The combs of both nests appeared to have been built in a single effort; there were no irregularities in outline, hexagonal pattern, cell height, or brood distribution to indicate that a smaller original comb had been enlarged.

All cells in both nests were sessile; that is, they were built directly on the surface of the tree trunk, which formed the bottoms of the cells (Jeanne, 1973). Cells were 5.2–5.4 mm in diameter and reached a depth of 20 mm. Those of the nest on the vertical trunk were angled downward 15° with respect to the trunk surface (Fig. 2).

Fig. 1. Intact nest of *Clypearia weyrauchi* (no. 2035). The nest is 25.5 cm long. The striations indicate the pattern of construction of the envelope, and converge on the entrance. The dark blotches above the envelope are 'windows' formed by the removal of carton, leaving only the translucent film coating the outer surface of the envelope.

Fig. 2. The nest shown in Fig. 1 with its envelope removed. The line of attachment of the envelope is visible on the bark surface. The comb is centered within the surface enclosed by the envelope, and does not contact the envelope.

The cells were constructed of the same crumbly carton as the envelope, and were similarly coated with a film of secretion. Thus the walls of the cells were layers of carton sandwiched between two layers of secretion, the latter providing the main strength for the cells. The coating lined the bottoms and walls of all cells, even shallow peripheral cells that had not produced adults, though in some cases the upper few mm near the rim of these cells lacked it, suggesting that these had recently been heightened by adding carton, but had not yet been coated.

Eggs were attached to the wall of the cell just above the bottom, and always in the uppermost angle of the cell, so that they hung downward nearly parallel to the flat cell bottoms. This position indicates that the queens faced upward on the comb while ovipositing.

Larvae about to pupate spin a silken cocoon completely lining the cell, including the bottom. This lining was distinguishable from the film of secretion lining the cells by virtue of its fibrous texture, greater strength, whiter color, and by its presence only in cells that contained meconia. The silk lining was relatively tough, and with care the entire cocoon, with the meconium at the bottom, could be removed intact from a cell.

The caps of the cocoons were set 2–6 mm below the rims of the cells, were slightly domed, and were translucent at the edges, grading to opaque white in the center. After the cocoon is completed the adults add scattered streaks and blotches of carton to the cap.

After the adult ecloses from a cell, the only treatment the cell receives is to have the cap trimmed away. The walls of the cell are not lowered, nor are the meconia removed, before the cell receives another egg.

No droplets of stored nectar were found in any of the cells of either nest.

Discussion

Though much detail is lacking from Araujo's description of the nest of *C. angustior* (Araujo, 1951), and Ducke's (1910) description of the nest of *C. apicipennis* is even less useful, a few points of comparison with that of *C. weyrauchi* are possible and seem worth making.

The most striking differences pertain to the envelope. While in *C. weyrauchi* there is a wide space separating comb and envelope, Araujo (1951) makes it clear that *C. angustior* starts the envelope by elevating the outer walls of the peripheral cells of the comb, so that the forms of the cells are visible on the sides of the covered nest.

The two species also differ with respect to the nest entrance, that of *C. angustior* protruding somewhat, while that of *C. weyrauchi* is flat.

Though Araujo (1951) states that the envelope of his nest of *C. angustior* contains numerous 'windows' of transparent secretion, he is not clear on their size or nature. He states that they are "perfectly reminiscent" of those

in the nest of *Metapolybia cingulata*. In that species the 'windows' are tiny and are incorporated as the envelope is being built. There is no film of secretion added later to the surface of the envelope. In *C. weyrauchi*, on the other hand, the windows are much larger and are made by the removal of carton from the inside of the film after the envelope is complete. It is not possible to be certain from Araujo's description whether the 'windows' and envelope of *C. angustior* are more like *Metapolybia cingulata* or *C. weyrauchi*, and he does not mention the existence of a surface film of secretion.

Finally, Ducke (1910) states that the nest of *C. apicipennis* seen by him had been enlarged, as indicated by irregularities in the outline of the envelope. On the other hand, neither nest of *C. weyrauchi* showed any evidence of having been enlarged, even though the larger one had evidently housed its colony for nearly a full normal developmental cycle. If *C. weyrauchi*, indeed, does not enlarge its nests once they are built, it is one of few species of New World polybiines not to do so.

Acknowledgments

I thank Roger Swain for assistance in the field. R. C. Koeppen kindly examined the carton material. I am grateful to the Conselho Nacional de Desenvolvimento Científico e Tecnológico for granting me permission to work in Brazil. Research supported by the College of Agricultural and Life Sciences, University of Wisconsin, Madison, and by National Science Foundation grants GB 33619 and BNS 77-04081.

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Received for publication August 8, 1978.